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Susceptibility of *Clostridium septicum* to 23 Antimicrobial Agents

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The in vitro susceptibility of *Clostridium septicum* was studied with a microtiter broth dilution method. Several antimicrobial agents demonstrated consistently good activity against the organism.

Clostridium septicum bacteremia in humans has been associated with a variety of malignancies, particularly leukemia and carcinoma of the colon (1, 4). The organism has been shown to cause soft tissue infections, including myonecrosis. It has also been suggested as a pathogen in neutropenic enterocolitis (5).

C. septicum, an obligate anaerobe, is beta-hemolytic on blood agar and highly motile. Growth can be overlooked, as isolates may form only a thin film on the culture plate without the definition of distinct colonies. *C. septicum* is differentiated from other clostridia by its carbohydrate fermentation reactions and its lack of lecithinase or lipase production.

Thirty-seven strains of *C. septicum* were tested in this study. At least 22 were human isolates; 17 of these were recovered from blood cultures, 3 were from wounds, and 1 was from stool. The identity of the strains recovered at Wadsworth Medical Center was established by biochemical testing according to the procedures of the Virginia Polytechnic Institute (3) and the Wadsworth Anaerobic Bacteriology Laboratory (7). Each susceptibility run included one or two control strains: *Bacteroides fragilis* WAL 3501 and *Bacteroides thetaiotaomicron* WAL 2926.

Laboratory standard powders were kindly supplied as follows: penicillin G, cefazolin, moxalactam, cycloserine, erythromycin, neomycin, cefamandole, and vancomycin from Eli Lilly and Co., Indianapolis, Ind.; cefoperazone, doxycycline, and bacitracin from Pfizer Inc., New York, N.Y.; thienamycin and cefoxitin from Merck, Sharp and Dohme, Rahway, N.J.; amikacin and BU 23-13 from Bristol Laboratories, Syracuse, N.Y.; rifampin from Ciba-Geigy Corp., Summit, N.J.; gentamicin from Schering Corp., Kenilworth, N.J.; cefotaxime from Hoechst-Roussel Pharmaceuticals, Inc., Somerville, N.J.; clindamycin from The Upjohn Co., Kalamazoo, Mich.; metronidazole from G. D. Searle and Co., Chicago, Ill.; chloramphenicol from Parke-Davis and Co., Detroit, Mich.; and ceftizoxime from Smith, Kline and French Laboratories, Philadelphia, Pa. Nalidixic acid was obtained from Sigma Chemical Co., St. Louis, Mo.

Minimal inhibitory concentrations were determined by a microtiter broth dilution method. Similar methods have been previously described by Barry et al. (2) and Rotilie et al. (6). Antimicrobial dilutions were prepared in brucella broth and dispensed into microtiter plates by using a Dynatech MIC 2000 (Cooke Laboratories Inc., Alexandria, Va.).

For susceptibility testing, a standardized bacterial suspension was prepared in brucella broth. A 10-μl sample was inoculated on the laboratory bench into each well of a microtiter plate containing 100 μl of antimicrobial agent solution per well. This resulted in a final inoculum concentration of approximately 10^5 bacteria per ml. The microtiter plates were incubated in an anaerobic jar at 37°C for 48 h. The minimal inhibitory concentration for each antimicrobial agent was read as the lowest concentration at which there was no growth in the well.

The results of this investigation are summarized in Table 1. *Bacteroides* control strains gave reproducible results, with minimal inhibitory concentrations ranging within one dilution of the mean. The newer nonpenicillin beta-lactam compounds were less active than penicillin, cefoxitin, and the older cephalosporins.

Prompt institution of appropriate antimicrobial therapy is important in the management of *C. septicum* infections, which may involve extensive tissue necrosis and be rapidly fatal. The excellent in vitro activity of penicillin demonstrated in this study confirms its place as the drug of choice. Clindamycin, chloramphenicol, metronidazole, and vancomycin may be reason-

TABLE 1. *Results of susceptibility testing of C. septicum*

Drug	No. of strains	Minimal inhibitory concentration (μg/ml)		
		Range	For 50% of strains	For 90% of strains
Penicillin	33	≤0.125 (all)	≤0.125	≤0.125
Cefazolin	33	≤0.125–0.25	≤0.125	≤0.125
Cefamandole	23	≤0.125–0.25	≤0.125	≤0.125
Cefoxitin	23	≤0.125–0.5	0.5	0.5
Moxalactam	33	≤0.125–4	0.5	1
Cefoperazone	33	≤0.125–2	1	2
Cefotaxime	33	1–16	8	16
Thienamycin	23	≤0.25–16	0.5	16
Ceftizoxime	33	8–64	32	64
Clindamycin	33	≤0.125 (all)	≤0.125	≤0.125
Chloramphenicol	23	0.5–2	2	2
Metronidazole	33	≤0.125–2	0.25	2
Erythromycin	23	0.25–1	0.5	1
Rifampin	33	≤0.125–0.25	≤0.125	≤0.125
Vancomycin	23	0.25–2	2	2
Bacitracin	12	0.25–1	0.25	0.5
Doxycycline	23	0.25–2	0.25	0.25
Nalidixic acid	33	2–8	4	4
Neomycin	33	32–>128	64	>128
Gentamicin	33	2–128	32	64
Amikacin	33	2–>128	32	64
Cycloserine	33	32–>128	>128	>128
BU 23-13	33	≤0.125 (all)	≤0.125	≤0.125

able alternative agents for the patient with a serious penicillin allergy.

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